

Environmental impacts of agricultural practices and water and soil conservation works : the case of the Merguellil catchment

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Abstract

Semi-arid agricultural areas are fragile territories where water and soil resources must be preserved. In such zones impact evaluation is difficult due to the lack of data. We focused on the upstream Merguellil watershed, located in central Tunisia, where several water and soil conservation works were built since 1990 to control water erosion and to protect the downstream area. The rapid expansion of such conservation measures raised the issue of their impact on soil and water resources. Our main goal is the impact assessment by LCA of the most relevant farming systems in our territory, taking into account on-site and off-site contributions to local and global impacts. Our strategy is to combine LCA with a participatory approach to integrate knowledge and perceptions of local actors and to provide elements on environmental impacts for all stakeholders. The first step was a territorial systemic participatory diagnosis to characterize the dynamics of the territory, to identify the natural resources and their uses, the developments of the agricultural practices and the characterization of the existing farming systems. This diagnosis was achieved through technical field visits and interviews with farmers. The second step was a territorial LCA of representative systems, mapping the different systems to consider the characteristics of their location (access to water, soil type...). Systemic territorial participatory diagnosis allowed to define a typology of production systems and to model the territory considering the interactions between these systems. Four types of production systems were identified to proceed with territorial LCA: olive and apricot system and olive and cereals system both in rainfed and irrigated combinations. LCA results are discussed for the most important midpoint indicators. This study demonstrated two major issues of LCA use for sustainable development in semi-arid watersheds: i) LCA results communication with stakeholders to fit with their understanding of the system and ii) localized impacts on soil and water resources, taking into account Water and Soil Conservation Works.

Introduction

In semi-arid areas, agriculture is based on resource “water and soil” limited, fragile and often overused. Indeed, it is essential to assess the impacts of agricultural practices in semi-arid regions on the use and degradation of these resources to choose and to develop an intensive and environmentally sustainable systems. Such impact assessment is difficult in semi-arid areas due to the lack of data. Our study area is the upper watershed of Merguellil, located in central Tunisia, characterized by a semi-arid climate, which brings together major environmental challenges: over-exploitation of water resources, accelerated land degradation and low availability of data. We Focused on the upstream Merguellil, Where Several water and soil conservation works Were built since 1990 to control water erosion and to protect the downstream area. The rapid expansion of conservation measures raised the issue of their impact on soil and water resources.

The environmental assessment method chosen for this study is the approach of the life cycle assessment (LCA), it is an international normalized method widely used to assess the potential environmental impacts of a system to optimize existing processes. It presents a characteristic of a global approach (all environmental impacts are considered) and life cycle (“cradle to grave”).

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Study area: Merguellil Watershed

Our study area is the Merguellil watershed located in Tunisia, a Mediterranean country. Indeed, in the Mediterranean region, soil degradation and water resources is a serious threat to humans and the natural environment. Agriculture in the Mediterranean is characterized by small size farms with a large number of farms are less than 10 hectares and they are economically less effective (Lacombe *et al.*, 2008).

The Merguellil Watershed is located in central Tunisia, it is characterized by a semi-arid climate with high rainfall variability. Its area is 1183 km² dam El Haouareb. To protect the downstream watershed of Merguellil against floods, the dam was built in 1989. The problems of the study area are the variable and limited resources, the high water use, low control over access to water, etc. These problems are also encountered in the whole Mediterranean basin, the basin Merguellil can then be regarded as an exemplary case (Leduc *et al.*, 2004).

The upstream of the Merguellil watershed, where a runoff is an important water resources and for the aquifers recharge, was equipped Water and Soil Conservation Works (WSCW) in the years 1990. They are built to address the problems of land degradation by erosion and a water scarcity. The WSCW are classified into two categories: the WSCW essentially consist of benches and wscw of the hydrographic network consisting mainly of hillside reservoirs.

The WSCW allow then the surface runoff reduction, the upstream flow collect and increasing the local infiltration and provide an additional water for irrigation. However, the study area is characterized by solar radiation and high evaporation rates, characteristic of the Mediterranean climate. Lacombe (2007) estimated that over 90% of runoff water collected by the WSCW are lost through evapotranspiration, without increasing the agricultural production.

Methodology

Our strategy is to combine the approach of the life-cycle assessment (LCA) with a participatory approach in the upstream of Merguellil watershed in central Tunisia to integrate the knowledge of local players and to create knowledge on the impacts environmental to policy makers, farmers, etc. The first step in our approach is to make territorial systemic participatory diagnosis that allows us to characterize of the dynamics of the territory, to identify the natural resources and their uses, the change of agricultural practices and the factors of these evolution, and the typology of farming systems.

The second step is the adaptation of the life cycle assessment framework for the use and change of land use. After that it will be necessary to define the indicators of impacts and the methods to calculate them. The third step is the identification of scenarios for our territory on which our methodology will be applied. The scenarios will be built with all stakeholders during a collective workshops.

Results and conclusion

A systemic territorial participatory diagnosis allowed us to understand the dynamics and functioning of the territory as well as the factors of this evolution, the typology of the farming systems and the conservation works and to model the territory considering the interactions between these systems. At territorial

level, the most significant event that has played an important role in the landscape and landuse, the access to water and to aquifers, the farming system adapted by farmers, is the series of 1969 floods. After the floods of 69, there was a intervention by the state at the level of territory with the construction of Water and Soil Conservation Works and there is also the development of irrigated agriculture more and more intensive; and therefore the change of cropping system from rainfed to irrigated cropping system. Indeed, it is important to assess the environmental impacts of uses and changes in land uses. It is also important in this study to consider the diversity of farming systems. The most common cropping system is arboriculture. For the irrigated systems, many farmers have abandoned the practice of vegetable crops due to lack of water availability and high consumption of inputs. The apricot is a demanding crop in water, it takes a lot of agricultural practices compared to olive trees and is sensitive to weather conditions (tree mortality in case of sustained lack of water) but is very productive. The apricot is a water consumer crop and it takes a lot of agricultural practices compared to olive trees and it is a very sensitive to weather conditions (tree mortality in case of a lack of water) but it is a very productive. Farmers believes that the apricot crop adequate to meet their needs but the olive tree which guaranteed the sustainability of their farms because it is resistant to extreme weather conditions and the lack of water.

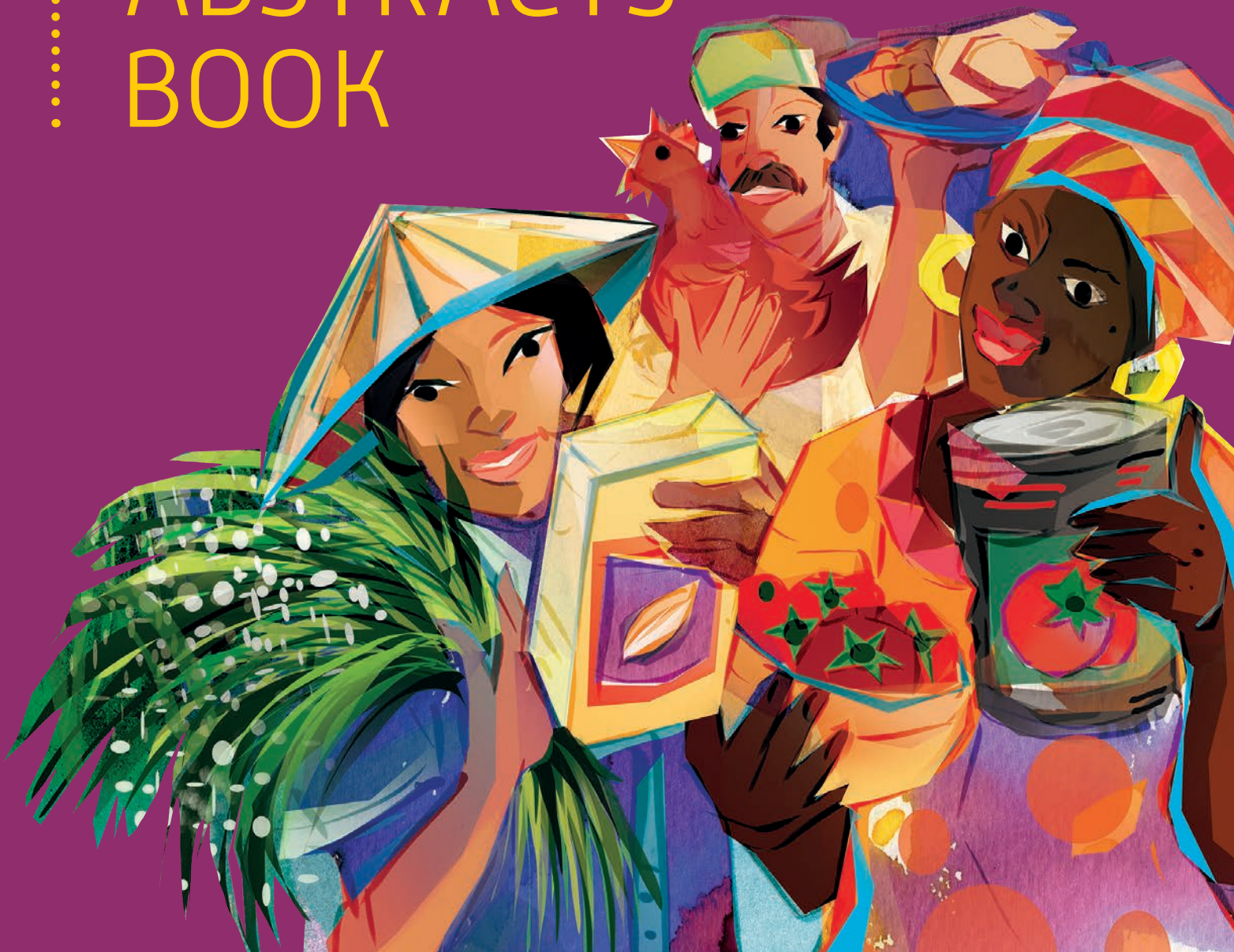
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Agri-Chains & Sustainable Development
> *Linking local and global dynamics*

ABSTRACTS BOOK



WELCOME ADDRESS



Welcome to AC&SD 2016

On behalf of the Scientific and Organizing Committees, it is a great pleasure to welcome you to the International Conference on Agri-chains and Sustainable Development (AC&SD 2016). This conference aspires to widen the debate about the role of agricultural value chains towards sustainable development. Year 2015 was a critical political and diplomatic milestone: the member states of the United Nations signed a new agenda for development, with the 17 Sustainable Development Goals (SDGs) placing sustainability at the core of international efforts. Development and academic actors are since then exploring new avenues for translating the SDGs into reality and implementing global and local frameworks and partnerships. Our conference aims at joining these efforts, with the consideration that agricultural value chains form spaces where local and global challenges to sustainability connect and within which local and global actors experiment and negotiate innovative solutions.

The scientific committee has assembled a very attractive program for AC&SD 2016 that seeks to cover and confront the diversity of realities behind agri-chains, from localized chains, embedded in specific places, to global value chains. In the parallel sessions, transformations of these agri-chains and their connections to sustainable development will be discussed by speakers from the academia, the civil society, the private sector and decision makers. This multi-stakeholder perspective will also be brought about in the plenary sessions. Here, world renowned keynotes and panelists to three high level round tables will discuss about the role and importance of evaluation, public and private institutions and innovations at different scales for transforming agri-chains towards sustainability transitions.

This edition gathers about 250 participants from 39 countries. AC&SD 2016 owes a lot to the scientific and organizing committees for preparing the program, and particularly to Brigitte Cabantous, Chantal Carrasco and Nathalie Curiallet for all the logistics, as well as to our support team of Alpha Visa that we warmly thank for their help.

We wish us all a fascinating, successful, inspiring and enjoyable AC&SD 2016 and we very much look forward to its result and to the strengthening of both a scientific community and a community of practice to implement the outcome!!

Estelle Biénabe, Patrick Caron and Flavia Fabiano,
Cirad Co-chairs AC&SD 2016

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